Appendix B

"Sample Television Signal Analysis Form"

TELEVISION SIGNAL ANALYSIS REPORT

CALL ______________ CHANNEL ____________ LOCATION ________________________

SHIFT __________________________________ FROM ______________ TO ______________

BY ____________________________________ DATE ________________________________

THE FOLLOWING PARAMETERS TO BE MEASURED FULL FIELD

		OUTGOING	DEMODULATED
BLANKING LEVEL	(72.5-77.5)%		
WHITE LEVEL	(10-15)%		
SETUP INTERVAL	(5-10) IRE Units		
HORIZONTAL SYNC PULSE WIDTH	(4.4-5.1) us.		
FRONT PORCH DURATION	(minimum 1.3) us.		
SYNC TO END-OF-BURST DURATION	(maximum 7.9) us.		
SYNC TO START OF VIDEO DURATION	(9.2 min) us.		
TOTAL HORIZONTAL BLANKING INTERVAL	(11.5 max) us.		
COLOR BURST LENGTH	(8-11) cycles		
COLOR BURST AMPLITUDE	(90-110)% of sync		
BREEZEWAY DURATION	(minimum 0.4) us.		
PULSE RISE TIME	(maximum 0.3) us.		
EQUALIZING PULSE WIDTH	(*nominal* 2.5 us.- 45-50% of H sync) us.		
SERRATION WIDTH	(3.8-5.1) us.		
SPIKING/OVERSHOOT/TILT	(MAXIMUM 5) %		
BLANKING/SYNC TIP VARIATION *(Scope must be triggered at FIELD RATE and SLOW D.C. RESTORATION)*	(MAXIMUM 5)%		
VERTICAL BLANKING INTERVAL	(18-21) LINES		

	OUTGOING	DEMODULATED	NOMINAL
SYNC AMPLITUDE	IRE	- IRE	-40 IRE
SUBCARRIER FREQUENCY	MHZ		

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Appendix C

"Video Frequency Broadcast Measurements"

		OUTGOING	DEMODULATED	NOMINAL
P-P AMPLITUDE	5 MHZ	____ IRE	____ IRE	____ 60 IRE
	1.5 MHZ	____ IRE	____ IRE	____ 60 IRE
	2.0 MHZ	____ IRE	____ IRE	____ 60 IRE
	3.0 MHZ	____ IRE	____ IRE	____ 60 IRE
	3.58 MHZ	____ IRE	____ IRE	____ 60 IRE
	4.2 MHZ	____ IRE	____ IRE	____ 60 IRE
AXIS SHIFT	.5 TO 4.2 MHZ	____ IRE	____ IRE	____ 60 IRE

COLOR BAR TEST SIGNAL (LINE 17 FIELD 2)

	OUTGOING	DEMODULATED	NOMINAL
VARIATION OF BLUE BAR VECTOR WITH RESPECT TO BURST	____ °	____ °	____ 0°

COMPOSITE TEST SIGNAL (LINE 18 FIELD 1)

	OUTGOING	DEMODULATED	NOMINAL
2T SIN SQUARED PULSE AMPLITUDE	____ IRE	____ IRE	____ 100 IRE?
12.5T SIN SQUARED PULSE AMPLITUDE	____ IRE	____ IRE	____ 100 IRE
12.5T CHROMA DELAY (POSITIVE OR NEG)	____	____	____ NONE
12.5T BASELINE DEVIATION POSITIVE	____ IRE	____ IRE	____ +0 IRE
12.5~~T~~ BASELINE DEVIATION NEGATIVE	____ IRE	____ IRE	____ +0 IRE
WHITE BAR AMPLITUDE	____ IRE	____ IRE	____ 100 IRE
WHITE BAR LINE TIME DISTORTION (TILT)	____ %	____ %	____ 0%
STAIRSTEP DIFFERENTIAL GAIN	____ %	____ %	____ 0%
STAIRSTEP DIFFERENTIAL PHASE	____ °	____ °	____ 0°

VIR TEST SIGNAL (LINE 19 FIELD 1)

	OUTGOING	DEMODULATED	NOMINAL
CHROMINANCE LOWER LIMIT	____ IRE	____ IRE	____ 50 IRE
CHROMINANCE UPPER LIMIT	____ IRE	____ IRE	____ 90 IRE
REFERENCE BLACK LEVEL	____ IRE	____ IRE	____ 7.5 IRE
LUMINANCE REFERENCE LEVEL	____ IRE	____ IRE	____ 50 IRE

SUBJECTIVE EVALUATION OF PICTURE QUALITY

____

	OUTGOING	DEMODULATED	NOMINAL
AUDIO LEVEL IN VU	____ VU	____ VU	____ VU

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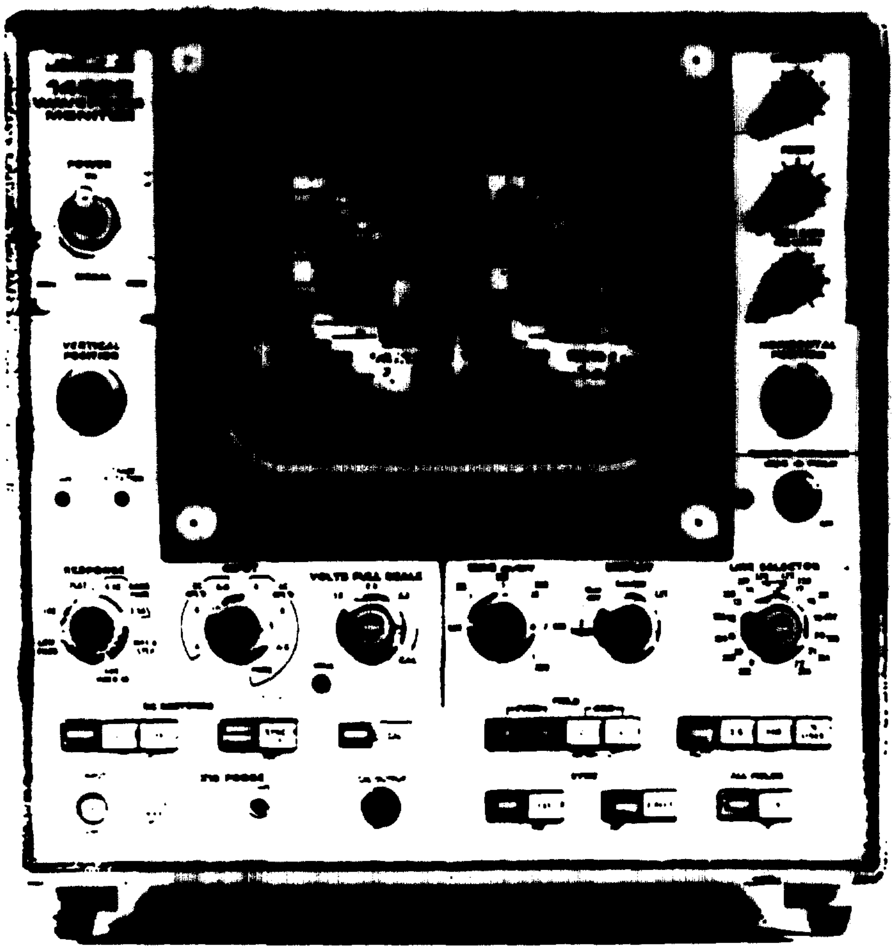
VIDEO FREQUENCY BROADCAST MEASUREMENTS

By
Stu Rasmussen

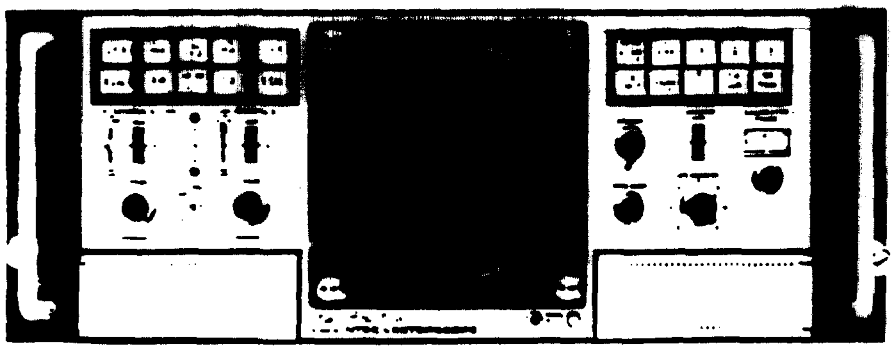
Equipment Requirements

Equipment Needed

In order to make satisfactory measurements of video signals, a certain minimum of equipment is required. For most measurements, a video waveform monitor is all that is needed, but to do a complete analysis of a system requires some additional equipment. The waveform monitor should include provision for making measurements on vertical interval test signals (VITS) and provide filtering to allow separate examination of the luminance and chrominance components of color television signals. The TEKTRONIX 1480 Waveform Monitor is recommended for these measurements. In addition to the waveform monitor, a vectorscope must be used for making certain measurements on color television system, particularly differential phase measurements. The luminance filter and color decoders of the TEKTRONIX 520A Vectorscope make it an excellent tool for evaluating both the luminance and chrominance channels of most video equipment. The waveform monitor and vectorscope are all that are required to accomplish these measurements, but if a greater level of accuracy is desired in timing measurements, a conventional oscilloscope with an associated digital counter/timer would be a great asset. Measuring the output of a television transmitter at baseband requires a demodulator. For greatest accuracy this demodulator should provide a zero carrier reference pulse for determining percentage of modulation, and ideally will use synchronous detection to avoid quadrature distortion.



1480 Series Waveform Monitor.



520A Vectorscope.

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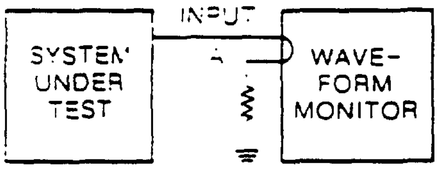
Video Amplitude Measurements

At one time or another, just about every component part of a video signal must be measured or adjusted. The overall amplitude of the signal and each of its component parts have strictly defined levels, and the relationship between the parts is also critical. We'll start with the measurement of overall amplitude.

Overall Amplitude

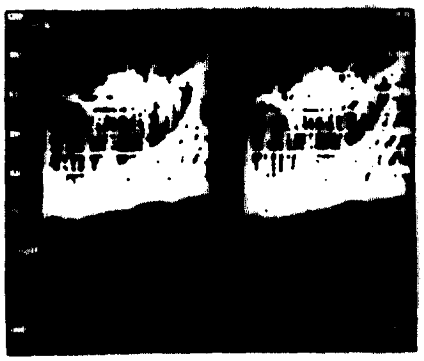


This measurement, also known as insertion gain, is a measurement of the peak-to-peak amplitude of the television signal. The signals that are distributed around the plant are all supposed to be 1 volt peak-to-peak, from sync tip to peak white. Any time the signal amplitude is less than or greater than this level, there is the possibility that some piece of equipment will either overload or possibly not give its best performance. To measure signal level, or insertion gain, set the waveform monitor to display a 1 volt peak-to-peak full scale signal, and then apply the signal to be measured to the video input. If its amplitude is greater or less than 1 volt, there is something amiss somewhere, and the signal should be adjusted to the correct amplitude. There is a chance that the incorrect level is caused by a distortion somewhere in the signal chain, so it would be well to adjust the variable gain control of the waveform monitor so that the signal amplitude is actually centered correctly between the 100 IRE and -40 IRE limits on the graticule. Once this is done, check to see that the ratio of picture amplitude to sync amplitude is correct. There should be 100 units of picture and 40 units of sync, disregarding any chrominance components that may be present. If the signal is correctly proportioned, but low or high in amplitude, it can be adjusted to the correct level. If there is an imbalance between the picture and sync, the cause of this disturbance should be found and corrected.

As an aid to accurately setting the video amplitude, the TEKTRONIX 1480 Series of waveform monitors provides an accurate comparison between a precise 1 volt calibration signal provided by the waveform monitor and the amplitude of the incoming signal. Feed the signal to be adjusted into the waveform monitor A input, set the DC RESTORER to SYNC TIP, and depress both the OPERate and CALibrate buttons simultaneously. The waveform display will show the video signal twice, with the two signals offset by exactly one volt. Adjust the incoming signal amplitude so that the peak white of the lower trace signal and the sync tip of the upper trace coincide. When this happens, the incoming signal is exactly one volt peak-to-peak. To locate a reference level for peak white, you may have to find a VIT signal that includes a white flag, such as the pulse and bar waveform. For greater accuracy in setting the signal level, increase the vertical gain of the waveform monitor to the 0.2 volt full scale position and fine tweek the signal level to 1 volt.

Overall Amplitude Measurement

1. Display the signal on the waveform monitor at 5 or 10 usec/div, with the VOLTS FULL SCALE at 1V CALibrated. Adjust the signal amplitude for 140 units, disregarding chrominance components.



2. The IRE response position can be used to remove chrominance, making this level setting easier.

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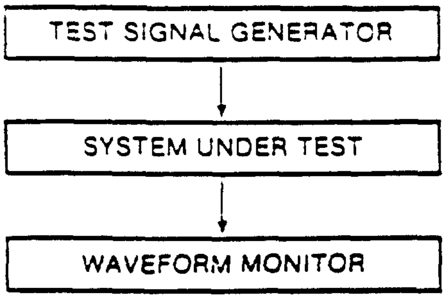
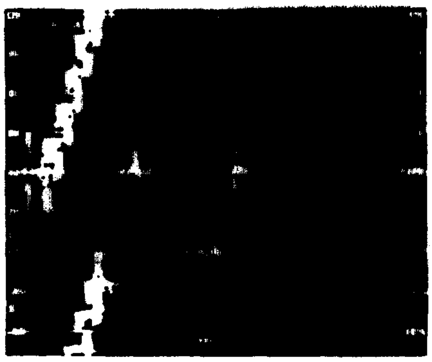
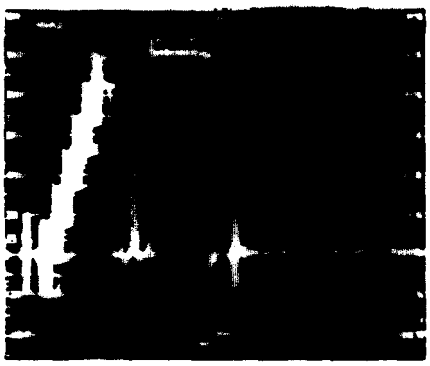


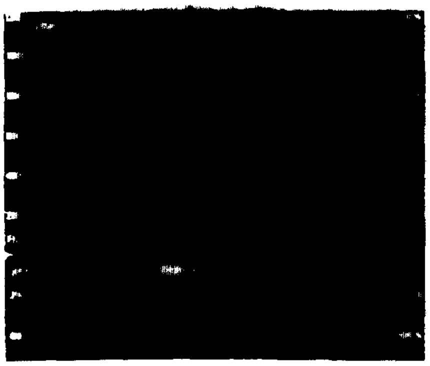


3. *For accurate level setting, display a test signal which contains a white reference. A VIT Composite signal is shown here. Select the SYNC TIP DC RESTORER mode.*



4. *Depress both the OPERate and CALibrate buttons simultaneously, and position the display so that the sync tip of the upper trace and the white flag of the lower trace are at the blanking level on the graticule.*

5. *Switch to 0.2 Volts/div to increase sensitivity.*



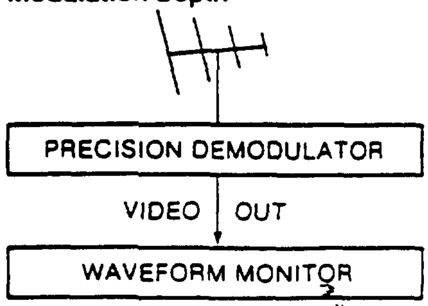
6. *Adjust the signal level until the sync tip and white flag are at the same level. This procedure accurately sets the video amplitude to 1 Volt p-p.*

7. *Check that the sync to picture ratio is correct, 40 units of sync and 100 units of picture.*

Demodulator Measurements

Off the air measurement of video signals imposes some restrictions on the test equipment being used. The waveform monitor and vectorscope will faithfully indicate the output of the demodulator, but there's no way to know if the demodulator is telling the truth. For most measurements, a quality demodulator, incorporating synchronous detection, is a must. The simple diode demod usually found at a transmitter site just won't do the job. Any signal measurement done at video baseband can be made from a suitable demodulator.

Percentage of Modulation, Modulation Depth



Connect the demodulator output to the waveform monitor, as shown. Locate the zero carrier reference pulse from the demodulator and set the demodulator output level so that the sync tip of the signal is at -40 units, and the zero carrier reference pulse is at +120 units. Now verify that the blanking level is at 0, and peak white of the transmitted signal is 100 IRE. If either blanking or peak white are not correct, there is cause for suspicion that something is amiss in either the demodulator or transmitter. By using the rf spectrum analyzer to examine the carrier signal, the source of trouble can be identified. The right hand scale on the waveform monitor graticule is calibrated in percentage of peak power, from zero at +120 IRE to 100% at sync tip. There is no way to determine transmitter output power using a demodulator, as direct reference to the output stage of the transmitter is necessary. Nevertheless, once power has been determined, the waveform monitor display will indicate percentage of this measured peak power.

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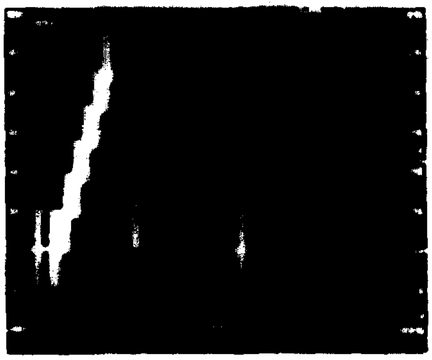
Demodulator Measurements

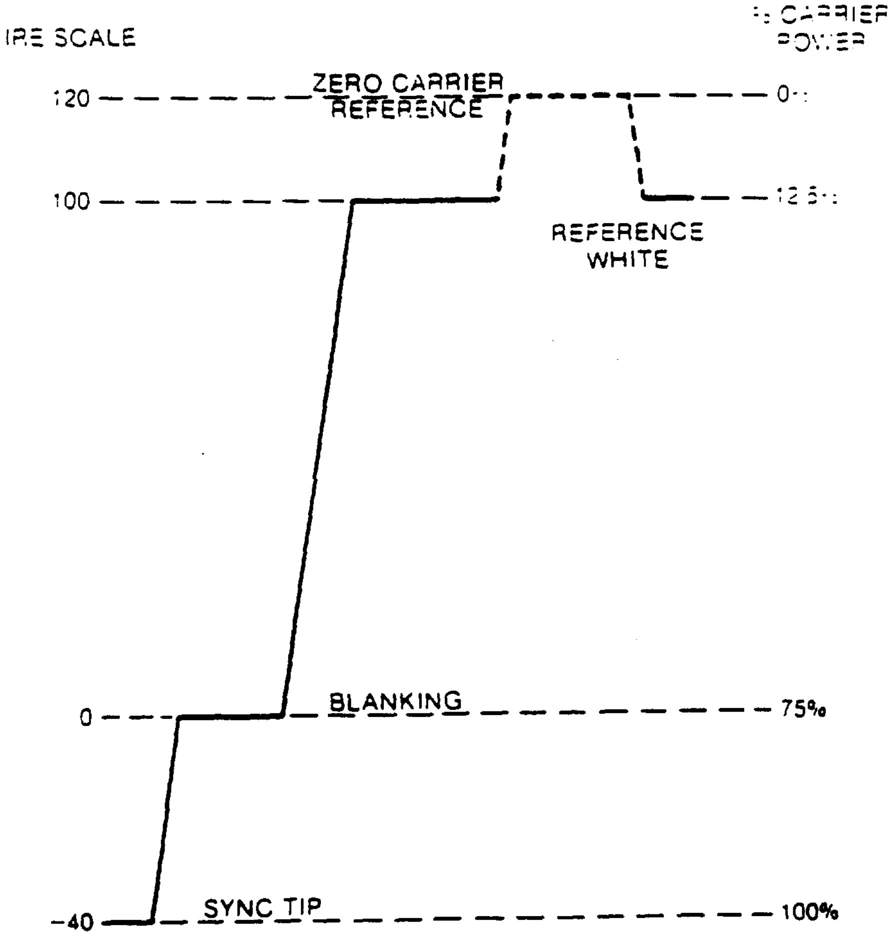


Vertical interval test signal from precision demodulator. The graticule scale at the right is calibrated in percentage of modulation. On a correctly adjusted system, sync tip is 100% power, blanking is 75% peak power, and reference white is 12½% peak power. The zero carrier reference pulse is inserted by the demodulator as an aid in determining carrier rf levels.

Sync Amplitude

The measured level of sync, from sync tip to blanking, is not as important as the relationship between sync and picture or between sync and zero carrier. 40/140 of the composite video signal should be sync. On a 1 volt signal, the sync amplitude should be 286 millivolts. At the transmitter, the sync amplitude should be equal to 25% of the overall signal amplitude, from sync tip to zero carrier. The relative levels of sync, picture, and zero carrier are shown below.

If gross distortions are introduced in a transmission system, the sync to picture ratio is the most apparent indicator. Some common sources of amplitude non-linearities are microwave transmission links and high powered visual transmitters. By its very nature, the transmitter is a tremendous source of amplitude distortions. In order to make the transmitter output look better, the signal fed to it is pre-distorted to compensate for the non-linearities introduced during modulation. This pre-distortion, or may we say pre-correction, is dependent on the average picture level of the signal, so there is some compromise on optimum equalization. A better solution to the transmitter distortion problem is to use an interactive corrector which samples the output signal and makes its corrections to the input signal to compensate for the transmitter abnormalities.



Relative levels of sync, picture and zero carrier.

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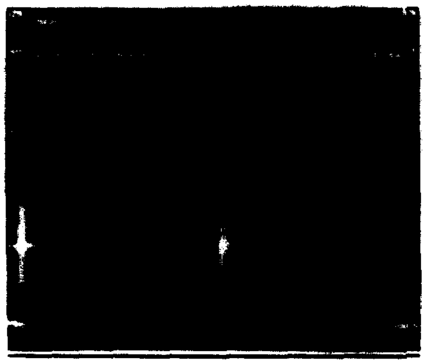
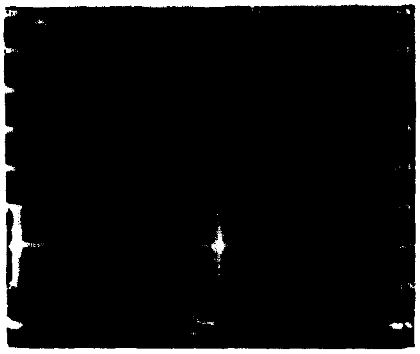


1. Sync should be 40/140 of the composite video signal.



2. Sync amplitude must be equal to 25% of the difference between peak power and zero power. Sync tip is 100% peak power and blanking should be 75% peak power.

Burst Amplitude

The color burst, from EIA standards, is to be equal in amplitude to the synchronizing signal, and centered on the blanking level. The FCC requires the burst on a transmitted signal to be within 90% to 110% of the amplitude of sync. This measurement can be made at either the transmitter input or from a demodulator. It is well worth considering that the Federal Communications Commission field inspectors make their measurements from an off the air signal, so it would be to your advantage to do likewise. To measure burst amplitude, the signal can be measured directly on the IRE scale of a waveform monitor, and should be 40 units peak to peak. It is easier, however, to compare the amplitude of burst to the sync signal to see if it is within specs. To do this, position the signal and adjust the VOLTS FULL SCALE and VARiable control until the sync signal fills the 100 IRE scale from blanking to +100. Now position the signal so

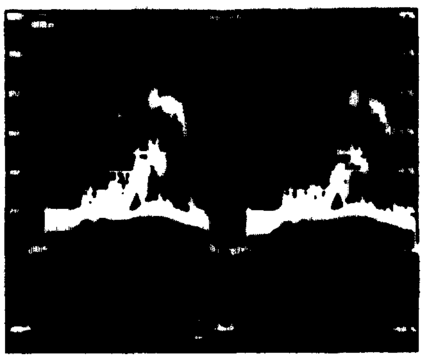
that the burst signal extends upward from blanking. The top of the burst envelope now corresponds to its amplitude relationship to the sync signal. For example, if the burst signal tip were at the 95 IRE unit line, burst is equal to 95% of sync amplitude. Using this technique, bursts must be between 90 and 110 units in height compared to sync at 100 units.

1. Adjust display until sync extends from 0 to 100 IRE.

2. Reposition the signal so that burst extends upward from the 0 IRE scale division. Burst amplitude must be between 90 and 110 units on the scale. Burst shown here is about 2% high, which is well within specifications.

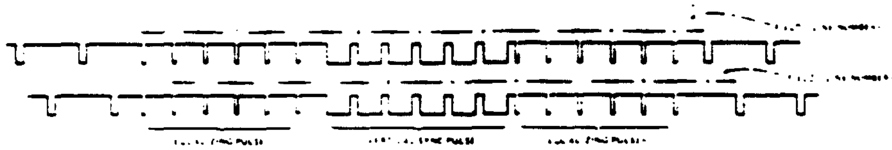
Setup

The FCC requires that the picture video black level be separated from blanking by a setup level of 7.5 (±2.5) IRE units. This setup level does not include color subcarrier components which may extend below this level. To measure setup, display a full field picture signal, and measure the level from blanking to the lowest portion of the picture signal. To eliminate chrominance components that may confuse this measurement, use the IRE filter position of the waveform monitor. Setup is measured between blanking and picture black, so if the picture does not have any areas which are black, the result of this measurement is not valid. In this case, wait until black is present in the picture and then perform the measurement.



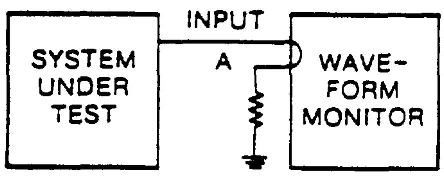
1. Picture black is separated from blanking by 9 IRE. Setup must be within the range of 5 to 10 IRE.

Synchronizing Timing Measurements



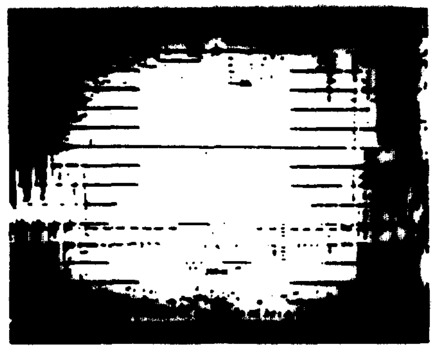
Format Check

The broadcast television signal must conform to the format diagrammed in FCC 73.699, Figure 6, and shown here in abbreviated form. Before making timing measurements on the signal, verify that the signal format is as shown here. Pay particular attention to the number of equalizing pulses and sync pulses contained in the vertical interval, and be certain that vertical blanking starts three lines before the start of the vertical sync pulse. Verify that the relative widths of the various pulses are approximately correct before proceeding with the actual timing measurements.



Synchronizing timing measurement setup.

1. Field 1 Blanking Interval.



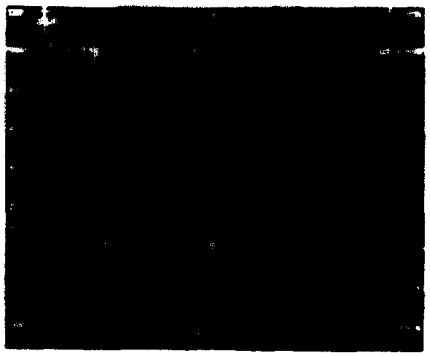
2. Field 2 Blanking interval.

Horizontal Blanking

Horizontal blanking, as defined by the FCC, is measured between points on the waveform at +4 IRE units. The minimum width for blanking is 10.49 microseconds, and the maximum width permissible by FCC specification is 11.44 microseconds. The maximum width specification applies to a measurement made at 90 IRE units above blanking. It is unlikely that many signals will be found to measure which have video immediately after blanking which reaches to 90 IRE, but if this is the case, the maximum timing applies.

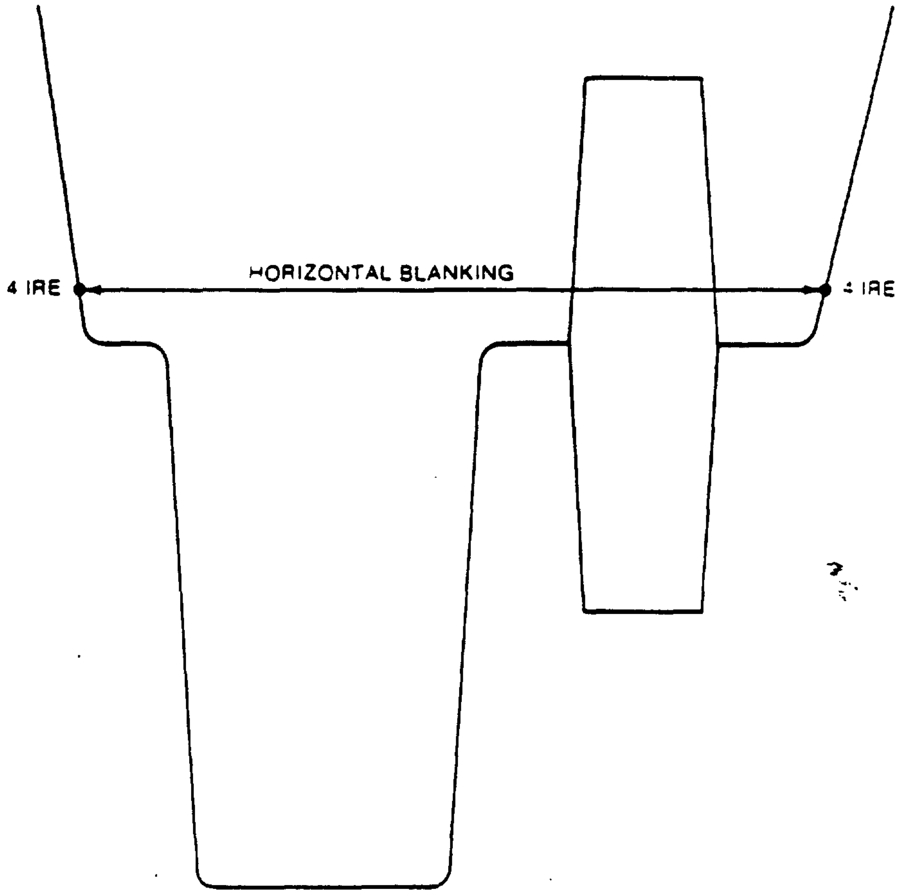
There is currently a group working within the broadcast industry engaged in examining this timing to recommend changes in the timing format to accommodate subcarrier to H sync phasing. The work of this group could result in changes to the blanking width specifications.

Horizontal Blanking Width



3. *To easily locate the +4 IRE (1/10 sync) level between which blanking is measured, use the vertical gain controls to set the sync pulse height to be 100 Units.*

4. *Without disturbing the setting of the Volts per Division and Variable controls, move the signal down until the blanking level is at the −10 IRE scale division. Blanking width is now measured where the signal crosses the 0 graticule division. In this photo, there are 10.7 divisions on the 0 IRE line, making blanking 10.7 microseconds.*



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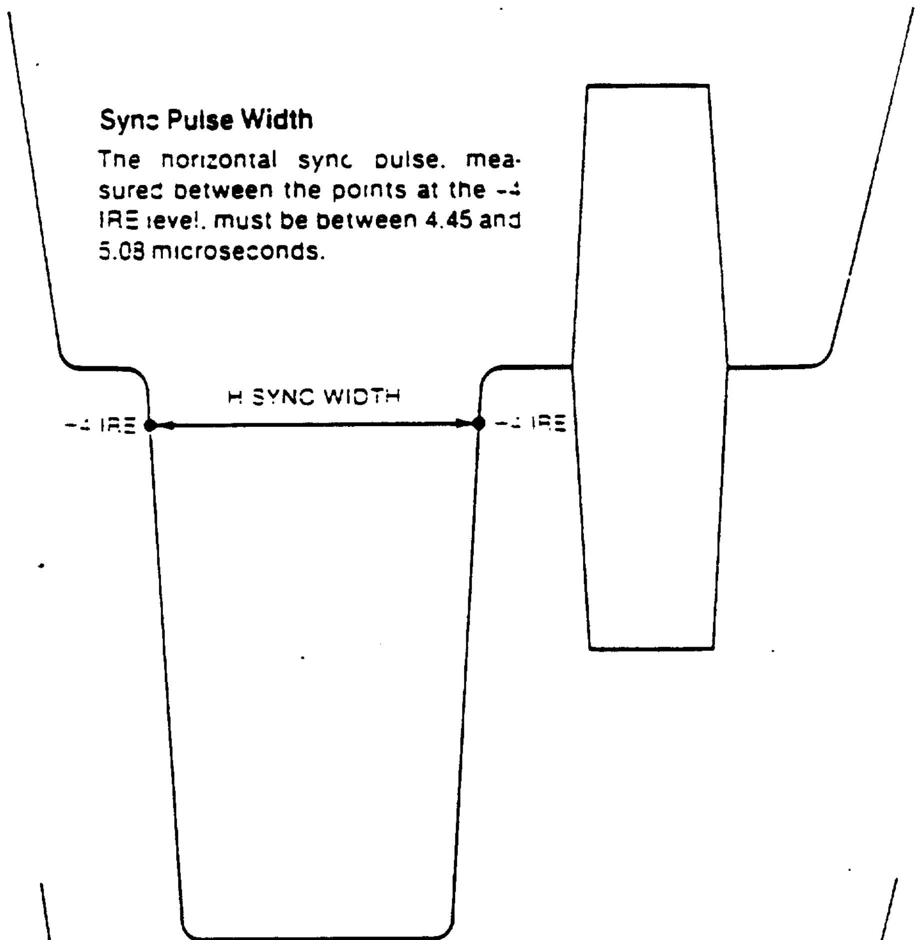
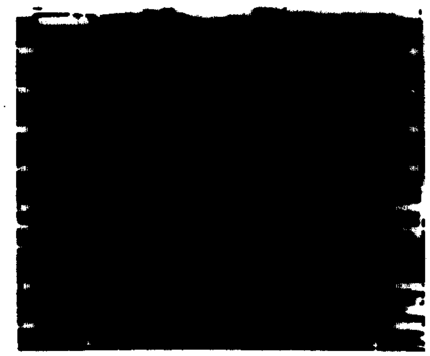
Sync Pulse Width

The horizontal sync pulse, measured between the points at the -4 IRE level, must be between 4.45 and 5.08 microseconds.

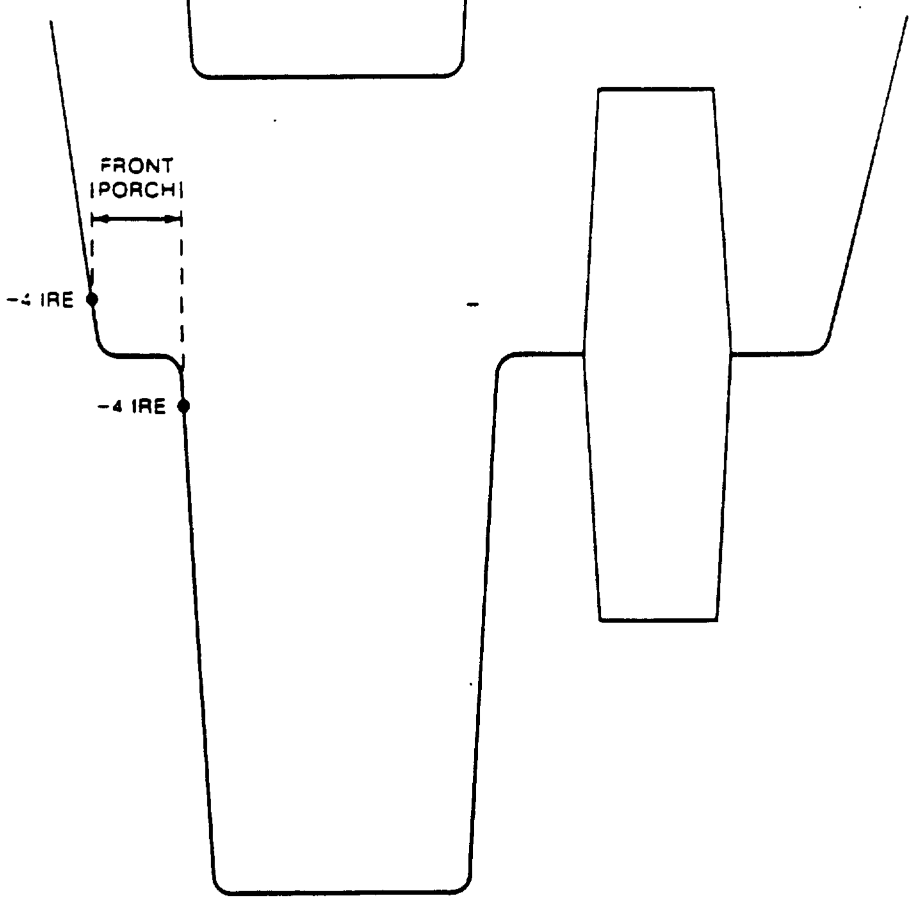


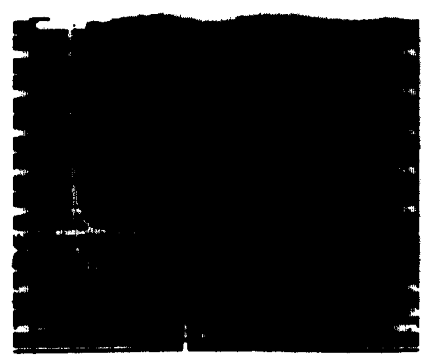


5. Set the sync amplitude to 100 units as for blanking measurements, then reposition the signal to put blanking at the +10 IRE division. Sync width is now measured on the 0 IRE graticule line. In this photo, sync width is 9.4 division, at 0.5 microseconds per division. 9.4 division × 0.5 µsec/div = 4.7 microseconds.

Front Porch Width

The front porch, between blanking and the leading edge of H sync, must be no less than 1.27 microseconds. This is measured from the -4 IRE level at blanking to the -4 IRE level on the leading edge of H sync.

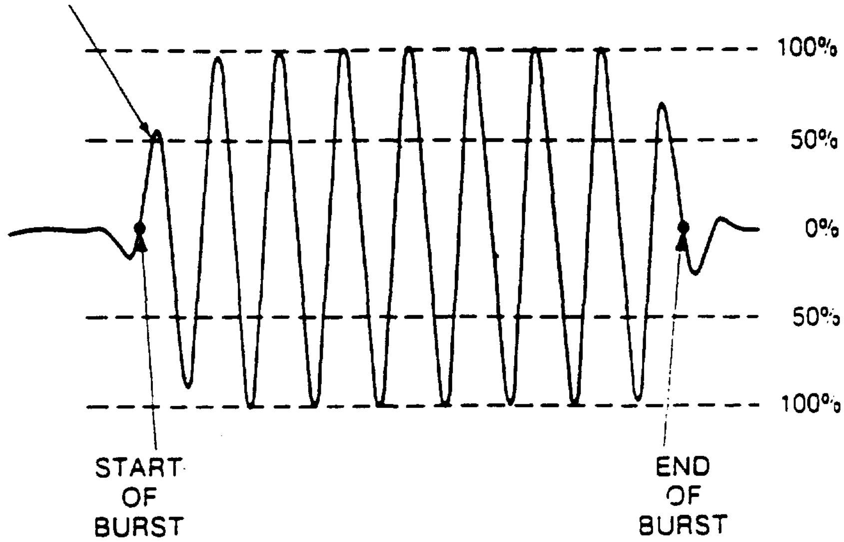


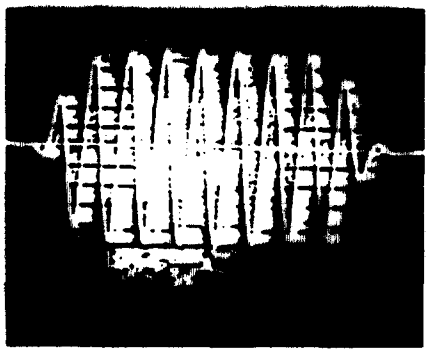


6. After setting sync to 100 units, the blanking level is set to -10 IRE, and the start of the front porch is on the 0 IRE line. The end of front porch is found by moving blanking to +10 IRE. These points are shown here as a double exposure.

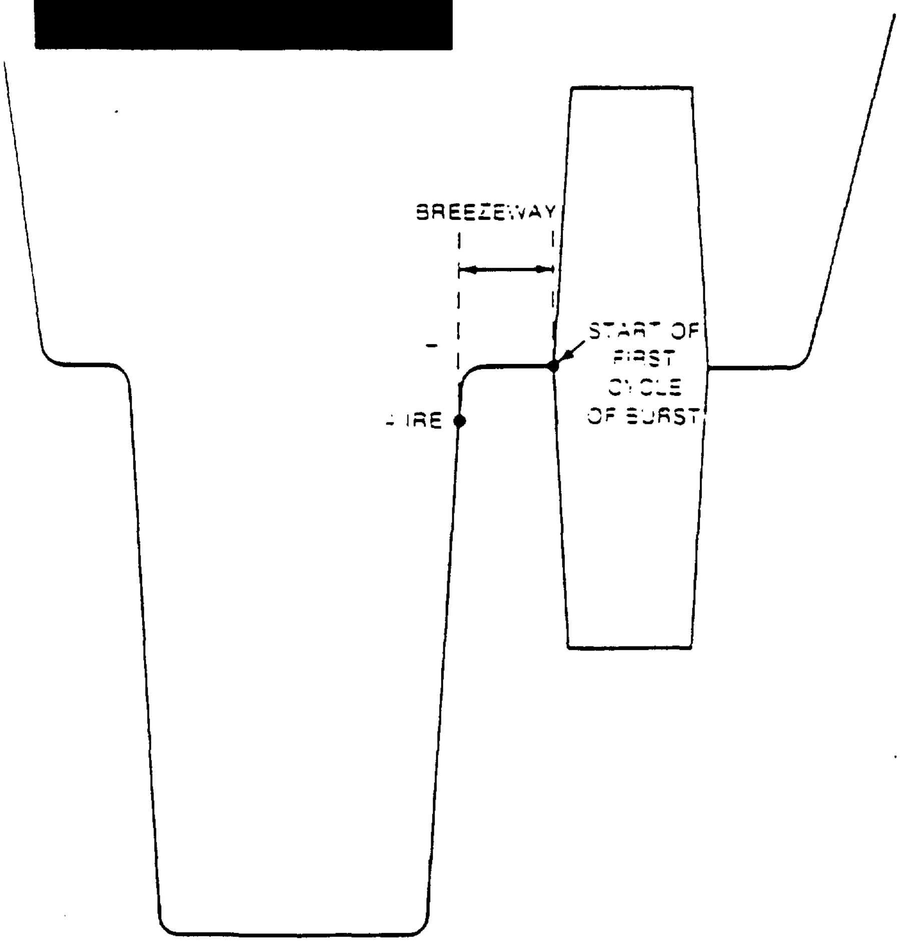
Burst

The present specification for burst requires a minimum of 8 cycles of burst. This may be revised in the near future to 9. The first cycle of burst is defined as the first cycle of burst, one half cycle of which equals or exceeds 50% of the peak amplitude of burst measured at the center of the signal. This first half cycle determines the start of burst and also its phase. The last cycle of burst is defined the same way at the end of the burst.





7. FCC standards require a minimum of 8 cycles of color burst. The burst shown here contains 8½ cycles.



Breezeway

The period between the trailing edge of the horizontal sync pulse and the first cycle of color burst must be no less than 381 nanoseconds, or 0.381 microseconds. This period is measured from the -4 IRE level on the trailing edge of H sync to the first zero crossing of the first cycle of the burst packet.

8. Double exposure showing breezeway measurement. Starting point at 1/10 of sync. Shown here, at 0.1 μsec/div, breezeway = 0.620 microseconds.

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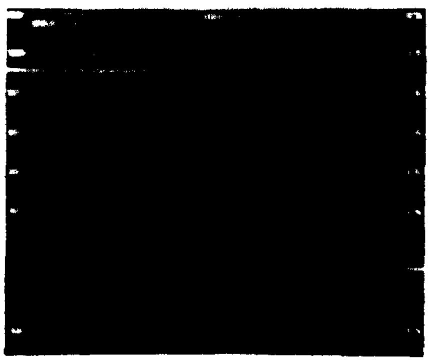
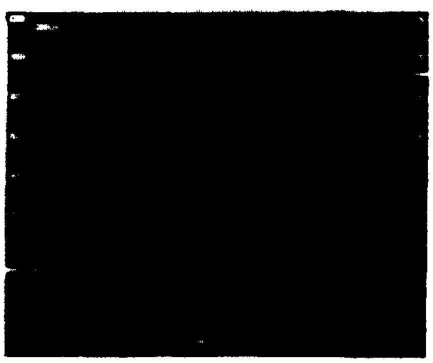
The period between the end of burst and the leading edge of picture is not specified, since its timing is defined by the other parameters and blanking width requirements.

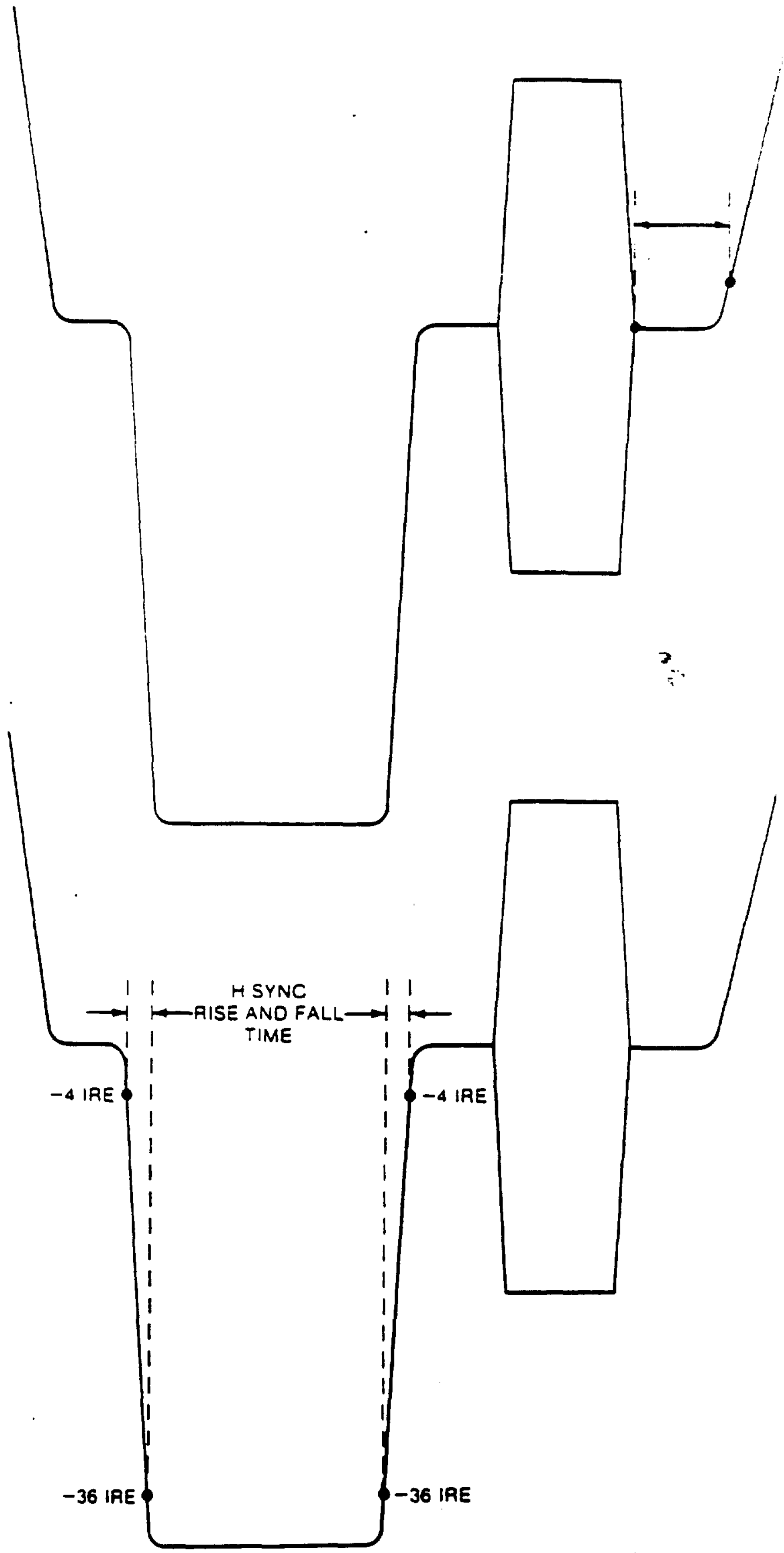
Rise Time of H Sync

The rise and fall times of the horizontal sync pulse, measured between the 10 and 90% points on the leading and trailing edges of the pulse, must be less than 0.250 microseconds (250 nanoseconds).



9. *Shown here at 0.1 µsec/division. Sync pulse leading edge, 0.120 µsec, (Figure 9) sync pulse trailing edge 0.125 µsec.*





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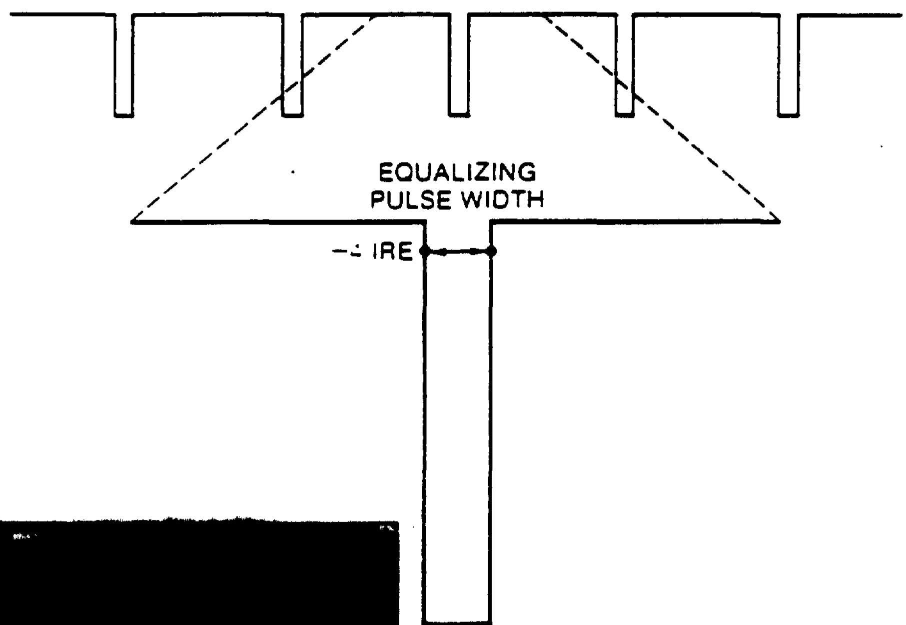
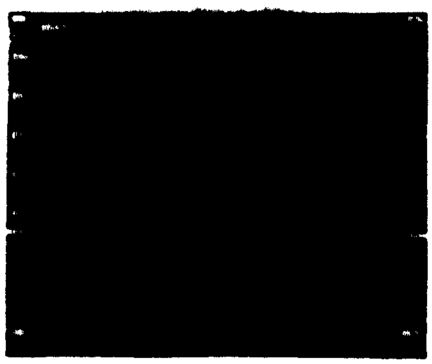
Vertical Blanking

Vertical blanking is the time between the last picture information at the bottom of one field and the first picture information at the top of the following field. Vertical blanking is measured from the leading edge of the first equalizing pulse. Measured in terms of time, vertical blanking must be greater than 1.17 milliseconds, but less than 1.33 milliseconds. In terms of scanning lines, the maximum vertical blanking is 21 lines. It is fairly standard in the industry to adhere to 21 lines of blanking, as the vertical interval lines preceding picture are often used for the transmission of vertical interval test signals.

Equalizing Pulse Width

The width of the equalizing pulses which precede and follow vertical sync should be 2.54 microseconds. The tolerance on equalizing pulses is that the area of the pulse must be between 45 and 50% of the area of a synchronizing pulse. It is a fairly simple matter to compare the relative widths of the pulses and make a valid comparison in that manner. The equalizing pulses can be viewed on a waveform monitor by using the variable line selector to trigger in the vertical interval. Be sure when making this measurement that the vertical interval is correctly formatted as described previously.





11. Measured between points at the 1/10 sync (−4 IRE) level. Shown here at 0.25 µsec/div: 2.40 µsec. Depending on the width of H sync, equalizers may be between 2.0 and 2.54 µsec.

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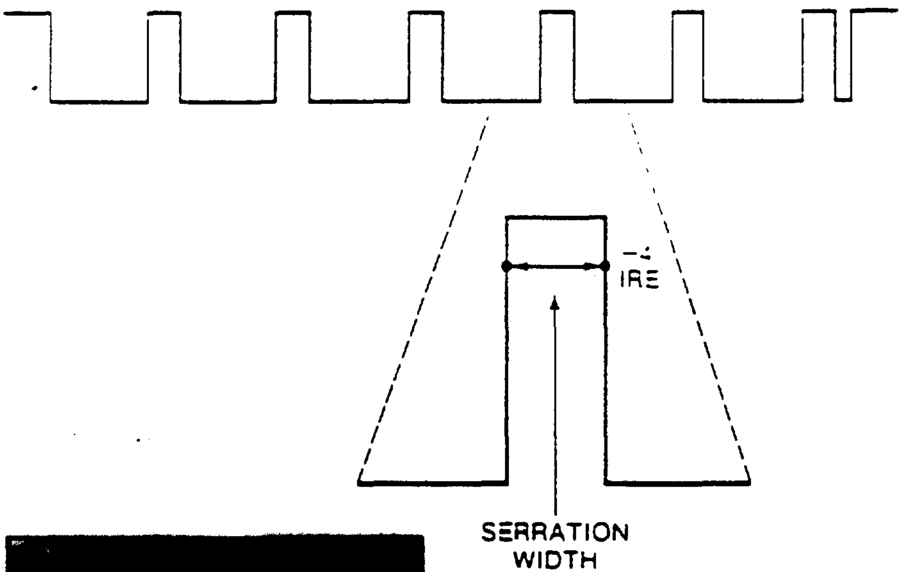
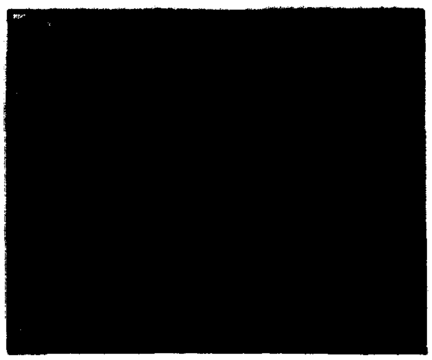
Vertical Sync Pulse

The vertical sync pulse should have a total width equal to three horizontal scanning lines. The serrations in the sync pulse must be between 3.8 and 5.1 microseconds, measured at the -4 IRE level. The rise and fall times of the equalizers and serrations must be less than 0.250 microseconds.



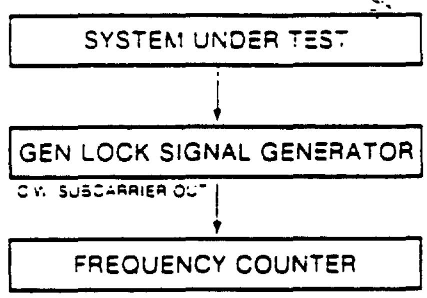


12. 3 full lines in duration, with serrations as shown here. 0.5 μsec/div, serration width = 4.5 μsec.

Subcarrier Frequency

The frequency of the color subcarrier or burst signal must be held within 10 Hz of 3.579545 MHz. The short time duration of the burst signal makes direct frequency counting quite inaccurate. Depending on the equipment available, burst frequency can be measured or verified in several ways.

Frequency Counter and Gen-Lock Device



If you have a digital frequency counter and a gen-lock signal generator with a cw subcarrier output, the generator can be locked to the video signal and the subcarrier frequency of the generator can be measured with the frequency counter.

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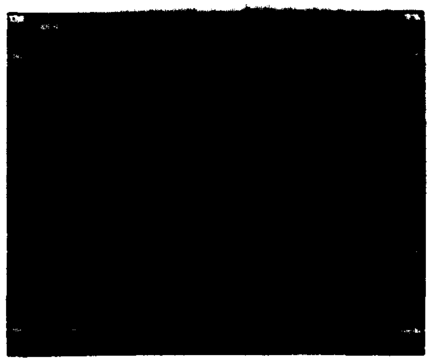
Field Time Distortions

Incorrect low frequency response, or the introduction of extraneous low frequency components into the system will result in field time distortions. If the coupling between stages of an ac coupled video amplifier is insufficient, low frequency roll-off will be evident in the signal. This appears as a difference in shading from the top to the bottom of the picture. Extraneous signals coupled into the television system, most notably power supply and power line hum, will also be seen as field time distortions, but their effect will be present regardless of the level of the picture signal. With color systems, in which the vertical rate is not locked to the power line frequency, hum will become evident as a long time distortion.

There is no adequate way to measure field time distortion on an in-service basis. A gross check on field time distortion while the system is operating can be made by viewing the blanking level or sync tip, and observing any variation between the vertical blanking interval and the picture level. This is an unsatisfactory test except for emergency troubleshooting. The waveform monitor DC RESTORER should be off for these tests.

Ideally, to test low frequency response, a 60 Hz squarewave would be used for out of service tests. Since some television equipment requires sync pulses to operate satisfactorily, a special 60 Hz square wave with synchronizing pulses is available from the Tektronix Test Signal Generators. This 60 Hz square wave is extremely sensitive to low frequency response errors, or field time distortions.

Other similar signals, such as a window or full field bar signal, may also be used. These signals are, however, much less sensitive to field time distortions than the 60 Hz square wave.



1. 60 Hz modified square wave used in testing for field time distortions.

2. Field time distortion. Notice tilt in square wave. This check is made with the DC Restorer in the waveform monitor turned off.

Line Time Distortions

Mid-frequency response errors account for the line time distortions present on television signals. Line time distortion is measured by viewing the tilt of the bar waveform on a pulse and bar signal. This measurement can be made on a full field or in-service basis.

In checking for line time distortion, low frequency hum and noise may thicken the trace, making an accurate determination of the amount of distortion difficult. If this is the case, attempt to minimize or eliminate their effect by using the FAST DC RESTORER (clamp) to remove the low frequency components. If this measurement is made on a full field signal, the 15 LINE mode can be used to further reduce hum and low frequency interference. The first and last portions of the bar waveform are not considered when measuring line time distortion, as the presence of any short time distortions will disturb the leading and trailing edges of the bar signal. The graticule supplied on current 1480 Series Waveform Monitors is designed to assist in making measurements of line time distortions.

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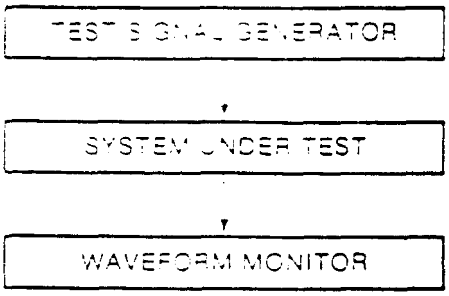
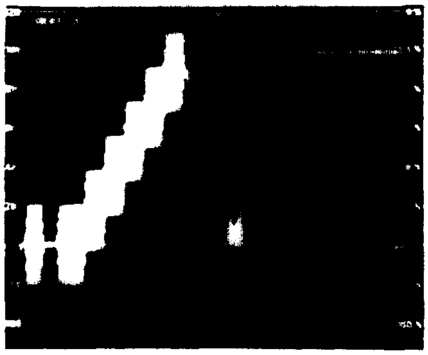
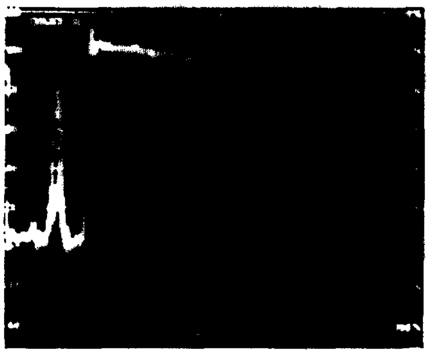




1. *The bar portion of this composite test signal may be used to measure line time distortions.*



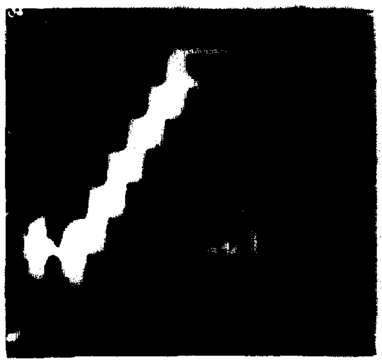
2. *5% line time distortion indicated from off the air measurement.*

Short Time Distortions

Errors in high frequency response result in short time distortions. To measure these short time distortions, the pulse and bar test signal is used, either as an in-service test or on a full field basis. By comparing the height of the pulse to the height of the center of the bar, the relative response at low and high frequencies can be compared. The ratio of the height of the pulse to the bar is a measure of the short time distortion present. To make the comparison between pulse and bar amplitude easier, the TEKTRONIX 1480 Series of waveform monitors allows the pulse to be "folded back" under the bar. A small amount of high frequency peaking will actually enhance the received picture by making fine details stand out. Excessive high frequency response, however, will introduce echoes or ghosts.

1. *Pulse and bar test signal. By comparing the pulse to the bar amplitude short time distortions can be measured.*

2. *Pulse height is down about units. This corresponds tc factor picture impairment o (K$_{PB}$).*



3. *The comparison of pulse tc amplitude is simplified by sweep foldback feature of TEKTRONIX 1480 Wave Monitor.*

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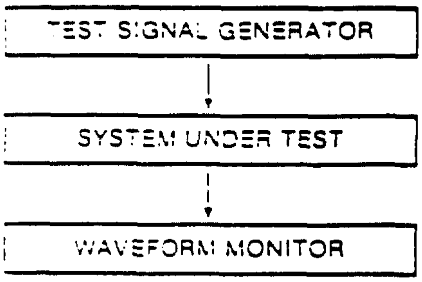
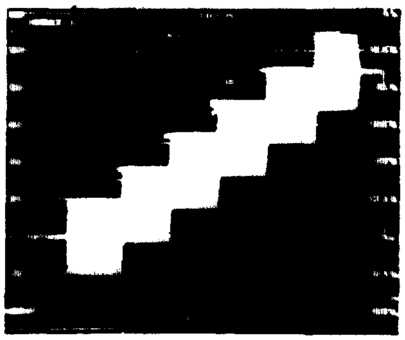
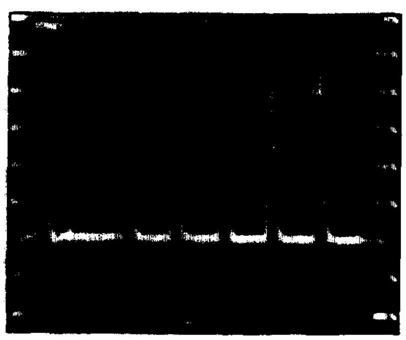
Luminance Nonlinear
Distortion, Cont.

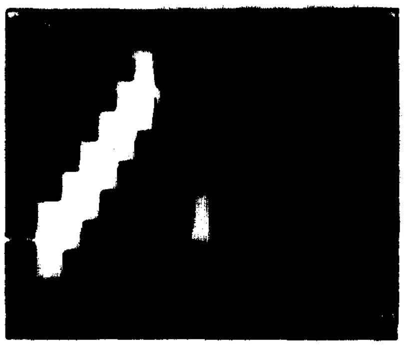




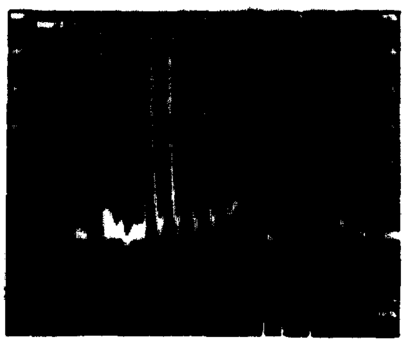
1. The stairstep or modulated stairstep is used for measuring luminance nonlinear distortion.



2. After passing through the stairstep differentiator and chrominance filter, the CRT display shows spikes in proportion to the amplitude of the stairstep risers.



3. The staircase of the composite test signal may also be used for this measurement.

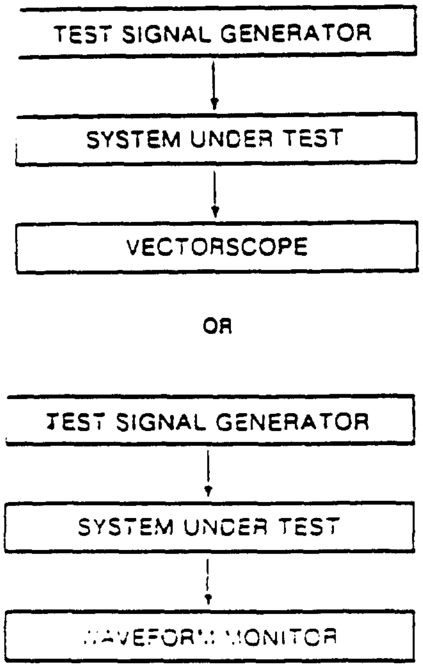


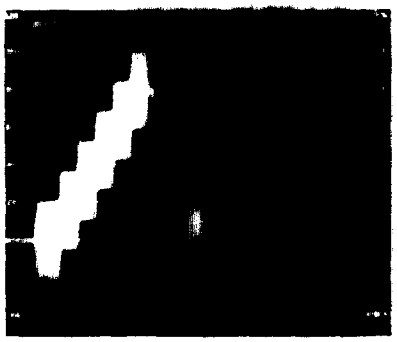
4. Off-air signal showing luminance nonlinear distortion. The tallest spike is set to 100 units, and the shortest spike pictured is down 14 units from 100.

Differential Gain

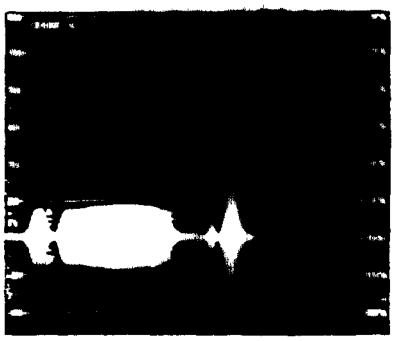
Differential gain, or as it is more correctly described, differential chroma gain, is a difference in amplitude response at the color sub-carrier frequency as the signal level changes. The value of differential gain may change as the average picture level or brightness changes, so several measurements of this distortion are necessary to fully evaluate the system response. The test signal used for differential gain measurements is the staircase signal with chroma added to the risers. Any difference in the amplitude of the chrominance component after transmission is differential gain. This parameter can be measured either in service or on a full field basis. To make the measurement, apply the test signal to the equipment to be tested, and monitor the output signal on the waveform monitor. Pass the signal through the chroma bandpass filter in the waveform monitor. Adjust the vertical sensitivity until the largest chroma envelope is 100 IRE peak. The difference in amplitude between this step and the smallest step displayed is a measure of the differential chroma gain. For out of service testing, this measurement is also made at 10% and 90% Average Picture Level to simulate the range of possible transmission parameters.

A vectorscope can also be used for measuring differential gain. The characteristics of the TEKTRONIX 520A Vectorscope allow measurements of differential gain distortion as small as 1%.

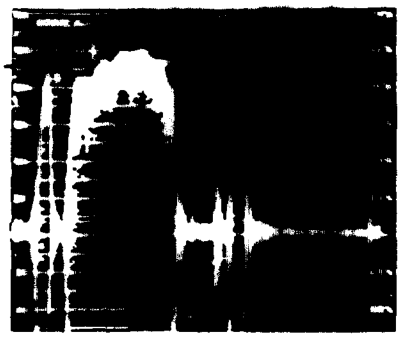




1. *The modulated stairstep is used to measure differential chroma gain.*



2. *Off-air signal viewed with waveform monitor chroma bandpass filter.*



3. *Signal expanded so that largest burst packet is 100 IRE peak. The amplitude difference between 100 and the smallest step is the amount of differential gain. Shown here, DG = 21%.*

Differential Phase

If the phase of the color subcarrier changes as a result of changes in the amplitude of the luminance signal, this distortion is known as differential phase. Differential phase is measured by using a stairstep signal with constant amplitude chrominance added to the stairstep risers. Viewing the subcarrier signal on a vectorscope, any phase difference between the chrominance on the steps indicates differential phase. The difference, in degrees, between the two steps which are farthest apart is a measure of the differential phase.

The TEKTRONIX 520A Vectorscope provides more accurate measurement of differential phase through the use of specially designed circuitry.

There is no FCC specification for differential phase per se, but the phase error of saturated color bars must be less than ±10 degrees. More conservative values of differential phase are well within the state of the art, so a tighter specification for your facility might be appropriate.

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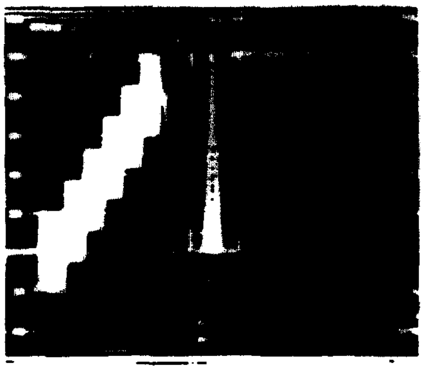
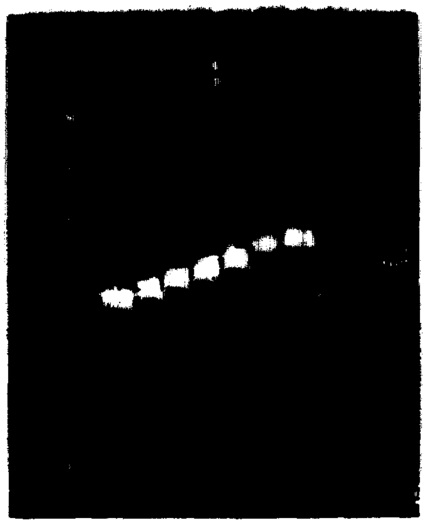


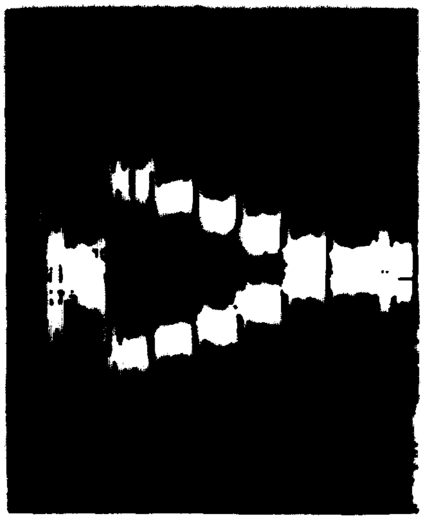
1. The modulated staircase is used to evaluate differential phase. As generated, the chrominance on the staircase is equal in phase and amplitude.

2. Viewed on a vectorscope in the VECTOR mode, the staircase chrominance component is positioned to the 0°-180° axis, and the gain is adjusted to place the staircase chroma at the perimeter of the circle.

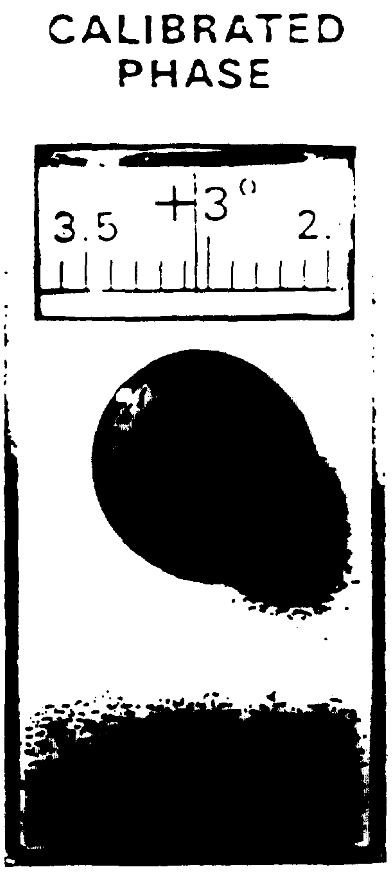


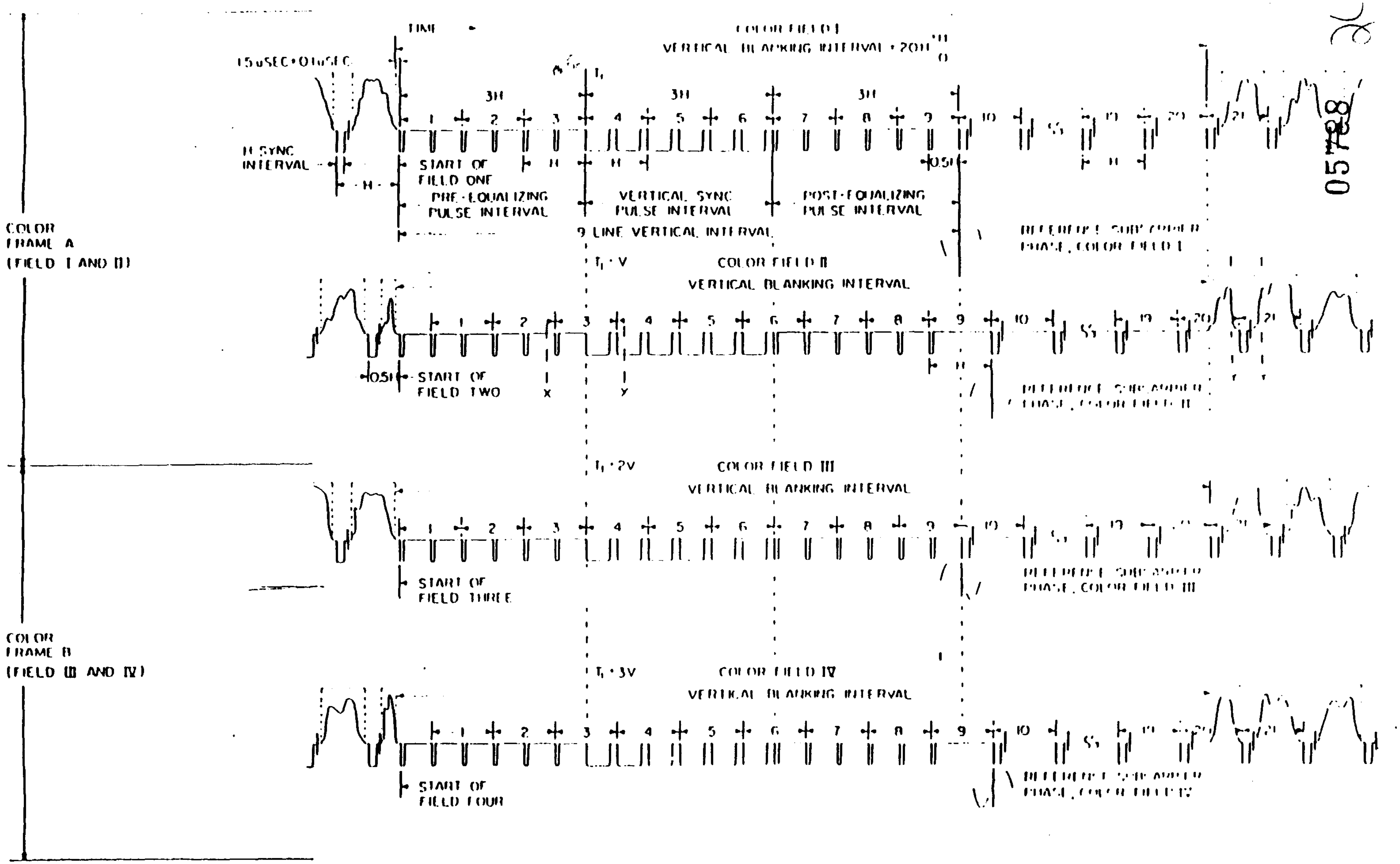
3. Depressing the DIFFerential PHASE button, the staircase chroma is positioned so that the reference point is on the 0° scale division. The peak of the signal corresponds to the differential phase error. In this photo, differential phase equals about 3°.

4. For greater accuracy in differential phase measurement, the double trace technique can be used. In this mode, the signal is set up as before, and the CALIBRATED PHASE shifter is set to 0. The CHannel A or CHannel B PHASE control, as appropriate, is adjusted so that the reference step signals are overlaid.



5. The CALIBRATED PHASE control is then adjusted to overlay the step being measured. The CALIBRATED PHASE dial now indicates the differential phase present. This method allows differential phase distortion as small as 0.1° to be measured.




TIME
COLOR FIELD I
VERTICAL BLANKING INTERVAL = 20H
1.5 uSEC ± 0.1 uSEC
3H
3H
3H
H SYNC
INTERVAL
START OF
FIELD ONE
PRE-EQUALIZING
PULSE INTERVAL
VERTICAL SYNC
PULSE INTERVAL
POST-EQUALIZING
PULSE INTERVAL
9 LINE VERTICAL INTERVAL
COLOR
FRAME A
(FIELD I AND II)
COLOR FIELD II
VERTICAL BLANKING INTERVAL
START OF
FIELD TWO
COLOR FIELD III
VERTICAL BLANKING INTERVAL
START OF
FIELD THREE
COLOR
FRAME B
(FIELD III AND IV)
COLOR FIELD IV
VERTICAL BLANKING INTERVAL
START OF
FIELD FOUR

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LPTV/Translator Maintenance Report Form

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Trinity Broadcasting Network
LPTV Maintanance Report Form

Call Sign ____________________

Output Chan. ________________

Final Amplifier Readings

	Measured	Factory Data
P.A. Voltage	________	________
P.A. Current(s)	________	________
	________	________
	________	________
	________	________
Fil. Volts	________	________
Control Grid Volts	________	________
Screen Volts	________	________
Output Power (Visual)	________	________
Aural Power	________	________
Reverse Power	________	________

Exciter Driver

Are The Following Normal (x)

________ L.O.

________ Mixer

________ Driver Currents

________ Multiple Voltages

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